Refine Search

Search Results -

Term	Documents
CONDUCTOR	769875
CONDUCTORS	450754
AAND	4873
AANDS	25
(((33 ADJ AAND) ADJ 32) AND 30 AND 31 AND CONDUCTOR).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	0
(CONDUCTOR AND L33 AAND L32 AND L31 AND L30).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	0

Database:
US Pre-Grant Publication Full-Text Database
US Patents Full-Text Database
US OCR Full-Text Database
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

Search: L39

Refine Search

Recall Text Clear Interrupt

Search History

DATE: Friday, September 15, 2006 Purge Queries Printable Copy Create Case

Set Name side by side	Query	Hit Count	Set Name result set
	DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=ADJ		
L39	Conductor and L33 aand L32 and L31 and L30	0	L39
L38	L37 and @pd > 20060915	0	L38
L37	L28 and L34 and L30	4	L37
L36	L35 and L34	4	L36
L35	L30 and L29	389	L35

L34	L33 and L32 and L31	345	L34
L33	(pulsed or (damped near wave) or (alternating near magnetic near field))	167979	L33
L32	(Earth near magnetic near field)	6061	L32
L31	L30 and (self near induct$5) or induct$5	697361	L31
L30	(short near duration) and (current or (high near current)) and switch	19292	L30
L29	(magnetic adj resonance) or NMR or MRI or EPR	244099	L29
L28	(324/300 |324/301 |324/302 |324/303 |324/304 |324/305 |324/306 |324/307 |324/308 |324/309 |324/310 |324/311 |324/312 |324/313 |324/314 |324/315 |324/316 |324/317 |324/318 |324/319 |324/320 |324/321 |324/322).ccls. or (600/410 |600/411 |600/412 |600/413 |600/414 |600/415 |600/416 |600/417 |600/418 |600/419 |600/420 |600/421 |600/422).ccls.	11627	L28
L27	4710713	175	L27
L26	5432446	56	L26
L25	5488342	20	L25
L24	5835995	7	L24
L23	5296811	13	L23
L22	5677630	30	L22
L21	5936404	23	L21
L20	5936404	23	L20
L19	5936404	23	L19
L18	5936404	23	L18
L17	L8 and L14 and L10	4	L17
L16	L15 and L14	4	L16
L15	L10 and L9	389	L15
L14	L13 and L12 and L11	345	L14
L13	(pulsed or (damped near wave) or (alternating near magnetic near field))	167979	L13
L12	(Earth near magnetic near field)	6061	L12
L11	L10 and (self near induct$5) or induct$5	697361	L11
L10	(short near duration) and (current or (high near current)) and switch	19292	L10
L9	(magnetic adj resonance) or NMR or MRI or EPR	244099	L9
L8	324/300-322.ccls. or 600/410-422.ccls.	11627	L8
L7	4710713	175	L7
L6	5432446	56	L6
L5	5488342	20	L5
L4	5835995	7	L4
L3	5296811	13	L3
L2	5677630	30	L2
L1	5936404	23	L1

END OF SEARCH HISTORY

Hit List

First Hit | Clear | Generate Collection | Print | Fwd Refs | Bkwd Refs | Generate OACS

Search Results - Record(s) 1 through 7 of 7 returned.

☐ 1. Document ID: US 5835995 A Relevance Rank: 99

L4: Entry 7 of 7 File: DWPI Nov 10, 1998

DERWENT-ACC-NO: 1999-009307
DERWENT-WEEK: 199901

TITLE: MRI method for imaging part of body e.g. heart - involves magnetising moments in selected region, using pulsed super conducting coil, to create field greater than 2 Tesla and receiving MRI signals using readout magnet providing uniform field

INVENTOR: CONOLLY, S; MACOVSKI, A

PATENT-ASSIGNEE: CONOLLY S (CONOI), MACOVSKI A (MACOI)

PRIORITY-DATA: 1996US-0738535 (October 28, 1996)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
US 5835995 A	November 10, 1998		007	G01V003/00

APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
US 5835995A	October 28, 1996	1996US-0738535	

INT-CL (IPC): G01V 3/00

ABSTRACTED-PUB-NO: US 5835995A
BASIC-ABSTRACT:

The method involves magnetising the moments in a selected region using a pulsed super conducting coil (11,13) to create a field of greater than 2 Tesla (20 kilogauss). MRI signals are received from the selected region using a readout magnet (12), with an axis perpendicular to that of the coil, providing a uniform field over the region.

ADVANTAGE - Produces images with high resolution and immunity to variations in the magnetic fields. Avoids distorting effects of materials with magnetic susceptibility and loud sounds caused by gradient coils. Enables use of stronger magnetic fields, for improved images, without heating and penetration problems.

ABSTRACTED-PUB-NO: US 5835995A

EQUIVALENT-ABSTRACTS:

CHOSEN-DRAWING: Dwg.2/5

DERWENT-CLASS: S01 S03 S05
EPI-CODES: S01-E02A2; S03-E07A; S05-D02B1;

☐ 2. Document ID: US 5835995 A Relevance Rank: 99

L4: Entry 6 of 7 File: USPT Nov 10, 1998

US-PAT-NO: 5835995
DOCUMENT-IDENTIFIER: US 5835995 A

TITLE: Localized pulsed superconductive MRI system

DATE-ISSUED: November 10, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Macovski; Albert	Menlo Park	CA	94025	
Conolly; Steven	Menlo Park	CA	94025	

APPL-NO: 08/738535 [PALM]
DATE FILED: October 28, 1996

INT-CL-ISSUED: [06] G01V 3/00

INT-CL-CURRENT:

TYPE IPC	DATE
CIPP G01 R 33/48	20060101

US-CL-ISSUED: 324/309; 324/307
US-CL-CURRENT: 324/309; 324/307

FIELD-OF-CLASSIFICATION-SEARCH: 324/309, 324/307, 324/306, 324/312, 324/314, 324/300, 324/322
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4573015	February 1986	Abe et al.	324/309
5057776	October 1991	Macovski	324/309
5629624	May 1997	Carlson et al.	324/309

ART-UNIT: 287

PRIMARY-EXAMINER: Arana; Louis M.

ABSTRACT:

A pulsed strong magnetic field, created with a superconductive coil, is applied to a selected region of the anatomy. Following the pulse a relatively low readout field is used along with a set of spatially orthogonal gradient fields parallel to the readout field. The readout field is chosen such that the noise arises primarily from body losses, and results in negligible susceptibility effects. Following excitation, the resultant signals from the precessing moments are detected, processed and used to make magnetic resonance images of the object. The field pulsing is made efficient using energy recovery.

10 Claims, 5 Drawing figures

☐ 3. Document ID: US 6885192 B2 Relevance Rank: 99

L4: Entry 5 of 7 File: USPT Apr 26, 2005

US-PAT-NO: 6885192
DOCUMENT-IDENTIFIER: US 6885192 B2

TITLE: SQUID detected NMR and MRI at ultralow fields

DATE-ISSUED: April 26, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Clarke; John	Berkeley	CA		
McDermott; Robert	Louisville	CO		
Pines; Alexander	Berkeley	CA		
Trabesinger; Andreas Heinz	Zurich			CH

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
The Regents of the University of California	Oakland	CA			02

APPL-NO: 10/360823 [PALM]
DATE FILED: February 6, 2003

PARENT-CASE:
RELATED APPLICATIONS This application claims priority of Provisional Application Ser. No. 60/355,577 filed Feb. 6, 2002, which is herein incorporated by reference.

inhomogeneous measurement fields. MRI in ultralow magnetic field is based on the NMR at ultralow fields. Gradient magnetic fields are applied, and images are constructed from the detected NMR signals.

45 Claims, 18 Drawing figures

☐ 4. Document ID: US 6900638 B1 Relevance Rank: 99

L4: Entry 4 of 7 File: USPT May 31, 2005

US-PAT-NO: 6900638
DOCUMENT-IDENTIFIER: US 6900638 B1

TITLE: Switching device to linearly conduct a current between a gradient amplifier and a gradient coil assembly of an MRI system

DATE-ISSUED: May 31, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Yair; Raphael	Haifa			IL
Shamir; Zvi	Haruzim			IL

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
GE Medical Technology Services, Inc.	Waukesha	WI			02

APPL-NO: 09/541354 [PALM]
DATE FILED: March 31, 2000

INT-CL-ISSUED: [07] G01V 3/00

INT-CL-CURRENT:

TYPE IPC	DATE
CIPS G01 R 33/38	20060101
CIPS G01 R 33/385	20060101

US-CL-ISSUED: 324/322; 324/318, 324/309
US-CL-CURRENT: 324/322; 324/309, 324/318

FIELD-OF-CLASSIFICATION-SEARCH: 324/322, 324/318, 324/307, 324/309, 324/312, 324/306, 324/300, 330/10, 361/20, 361/100, 307/417, 318/138, 327/461
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw D

☐ 5. Document ID: US 6914431 B2 Relevance Rank: 99

L4: Entry 3 of 7 File: USPT Jul 5, 2005

US-PAT-NO: 6914431
DOCUMENT-IDENTIFIER: US 6914431 B2

TITLE: MRI system with pulsed readout magnet

DATE-ISSUED: July 5, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Havens; Timothy J.	Florence	SC		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
GE Medical Systems Global Technology Company, LLC	Waukesha	WI			02

APPL-NO: 10/249089 [PALM]
DATE FILED: March 14, 2003

INT-CL-ISSUED: [07] G01V 3/00

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	G01 R 33/38	20060101
CIPS	G01 R 33/48	20060101

US-CL-ISSUED: 324/318
US-CL-CURRENT: 324/318

FIELD-OF-CLASSIFICATION-SEARCH: 324/300-309, 324/318-320, 335/296, 335/300-302, 335/306
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
5291169	March 1994	Ige et al.	
5389909	February 1995	Havens	
5517168	May 1996	Dorri et al.	335/301

5517169	May 1996	Laskaris et al.	335/301
5521571	May 1996	Laskaris et al.	335/216
5574417	November 1996	Dorri et al.	335/216
5650903	July 1997	Gross et al.	
5696476	December 1997	Havens et al.	
5835995	November 1998	Macovski et al.	324/309
5999075	December 1999	Laskaris et al.	335/299
6100780	August 2000	Dorri et al.	335/216
6163154	December 2000	Anderson et al.	324/320
6208143	March 2001	Conolly et al.	324/319
6404197	June 2002	Anderson et al.	324/311
6570475	May 2003	Lvovsky et al.	335/216
6593742	July 2003	Conolly et al.	324/318
6600318	July 2003	Kakugawa et al.	324/318
6646836	November 2003	Yoshikawa	361/19

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
0 757 256	July 2000	EP	

ART-UNIT: 2859

PRIMARY-EXAMINER: Shrivastav; Brij

ASSISTANT-EXAMINER: Vargas; Dixomara

ATTY-AGENT-FIRM: Vogel; Peter J.

ABSTRACT:

A Magnetic Resonance Imaging (MRI) system 50 is provided including a superconducting magnet coil assembly 54. The magnet coil assembly 54 includes a superconducting magnet 82 and forms an imaging volume 60. The superconducting magnet 82 generates a polarizing field in the imaging volume 60. A readout magnet 106 generates a readout field in the imaging volume 60. A controller 102 is electrically coupled to the readout magnet 106 and pulses the readout magnet 106 to generate a uniform magnetic field through the imaging volume 60. A method for performing the same is also provided.

20 Claims, 9 Drawing figures

☐ 6. Document ID: US 7053610 B2 Relevance Rank: 99

L4: Entry 2 of 7 File: USPT May 30, 2006

Y.R. Chemla, H.L. Grossman, Y. Poon, R. McDermott, R. Stevens, M.D. Alper, and J. Clarke, "Ultrasensitive magnetic biosensor for homogeneous immunoassay," PNAS, vol. 97 (No. 26), p. 14268-72, (Dec. 19, 2000). cited by other

ART-UNIT: 2859

PRIMARY-EXAMINER: Shrivastav; Brij B.

ATTY-AGENT-FIRM: Milner; Joseph R.

ABSTRACT:

Nuclear magnetic resonance (NMR) signals are detected in microtesla fields. Prepolarization in millitesla fields is followed by detection with an untuned dc superconducting quantum interference device (SQUID) magnetometer. Because the sensitivity of the SQUID is frequency independent, both signal-to-noise ratio (SNR) and spectral resolution are enhanced by detecting the NMR signal in extremely low magnetic fields, where the NMR lines become very narrow even for grossly inhomogeneous measurement fields. MRI in ultralow magnetic field is based on the NMR at ultralow fields. Gradient magnetic fields are applied, and images are constructed from the detected NMR signals.

20 Claims, 18 Drawing figures

☐ 7. Document ID: US 20040066194 A1 Relevance Rank: 99

L4: Entry 1 of 7 File: PGPB Apr 8, 2004

PGPUB-DOCUMENT-NUMBER: 20040066194
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20040066194 A1

TITLE: Magnetic field generating assembly and method

PUBLICATION-DATE: April 8, 2004

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY
Slade, Robert Andrew	Oxon		GB
Hawkes, Robert Carter	Cambridge		GB
Lucas, Alun J.	Royston		GB
McDougall, Ian Leitch	Oxon		GB

APPL-NO: 10/466095 [PALM]
DATE FILED: July 11, 2003

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	DOC-ID	APPL-DATE

GB	0100900.0	2001GB-0100900.0	January 12, 2001
GB	0130121.7	2001GB-0130121.7	December 17, 2001

PCT-DATA:

DATE-FILED	APPL-NO	PUB-NO	PUB-DATE	371-DATE	102(E)-DATE
Jan 11, 2002	PCT/GB02/00111				

INT-CL-PUBLISHED: [07] G01V 3/32

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	G01 V 3/32	20060101
CIPS	G01 R 33/38	20060101
CIPS	G01 V 3/18	20060101

US-CL-PUBLISHED: 324/318
US-CL-CURRENT: 324/318

REPRESENTATIVE-FIGURES: 4A

ABSTRACT:

A magnetic field generating assembly comprises a magnetic field generation system (7, 8) for generating, in a first mode, a first, relatively strong static magnetic field in a working volume (71) located outside the assembly, and for generating, in a second mode, a second, static magnetic field in the working volume in a second mode. In the second mode the magnetic field in the working volume (71) is weaker but more uniform than the first relatively strong magnetic field.

Clear | Generate Collection | Print | Fwd Refs | Bkwd Refs | Generate OACS

Term	Documents
"5835995"	7
5835995S	0
"5835995".PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	7
(5835995).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	7

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Search Results - Record(s) 1 through 20 of 20 returned.

☐ 1. Document ID: US 6348792 B1 Relevance Rank: 99

L5: Entry 14 of 20 File: USPT Feb 19, 2002

US-PAT-NO: 6348792
DOCUMENT-IDENTIFIER: US 6348792 B1

TITLE: Side-looking NMR probe for oil well logging

DATE-ISSUED: February 19, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Beard; David	Houston	TX		
Reiderman; Arcady	Houston	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Baker Hughes Incorporated	Houston	TX			02

APPL-NO: 09/677359 [PALM]
DATE FILED: October 2, 2000

PARENT-CASE:
CROSS REFERENCES TO RELATED APPLICATIONS This applications claims priority from U.S. Provisional Patent Application Ser. No. 60/221,078 filed on Jul. 27, 2000.

INT-CL-ISSUED: [07] G01V 3/00

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	G01 V 3/32	20060101
CIPS	G01 R 33/44	20060101
CIPS	G01 V 3/18	20060101

US-CL-ISSUED: 324/303; 324/300, 324/307
US-CL-CURRENT: 324/303; 324/300, 324/307

FIELD-OF-CLASSIFICATION-SEARCH: 324/303, 324/300, 324/318, 324/307, 324/309, 324/322
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4350955	September 1982	Jackson et al.	324/303
4717877	January 1988	Taicher et al.	324/303
5055787	October 1991	Kleinberg et al.	324/303
5488342	January 1996	Hanley	335/306
5646528	July 1997	Hanley	324/303
6023164	February 2000	Prammer	324/303

ART-UNIT: 2862

PRIMARY-EXAMINER: Williams; Hezron

ASSISTANT-EXAMINER: Shrivastav; Brij B.

ATTY-AGENT-FIRM: Madan, Mossman & Sriram, P.C.

ABSTRACT:

A side-looking NMR logging tool incorporates a permanent magnet arrangement having a magnetization direction oriented towards a side of the tool and a dipole RF antenna displaced towards the front of the tool. The magnet arrangement produces a shaped region of investigation in front of the tool wherein the magnetic field has a uniform field strength and the RF field has a uniform field strength in a direction orthogonal to the static field. The shaping of the static field is accomplished by the magnet arrangement comprising a plurality of magnets having parallel magnetization or by a single shaped magnet. The antenna arrangement includes a gapped core made of non-ferritic soft material for increasing the antenna efficiency. The magnet arrangement also reduces ringing in the core and the antenna. An optional RF shield is used to reduce NMR signals from borehole fluids.

36 Claims, 12 Drawing figures

☐ 2. Document ID: US 6411087 B1 Relevance Rank: 99

L5: Entry 13 of 20 File: USPT Jun 25, 2002

US-PAT-NO: 6411087
DOCUMENT-IDENTIFIER: US 6411087 B1

TITLE: NMR logging tool with Hi-Tc trap field magnet

DATE-ISSUED: June 25, 2002

pp. 625-628.
Yukikazu Iwasa, Electromaglev ("Active-Maglev")--Recent Results; The 1998 International Workshop on Superconductivity, Jul. 12-15, 1998, Okinawa, Japan.

ART-UNIT: 2862

PRIMARY-EXAMINER: Lefkowitz; Edward

ASSISTANT-EXAMINER: Shrivastav; Brij B.

ATTY-AGENT-FIRM: Madan, Mossman & Sriram, P.C.

ABSTRACT:

Trapped field magnets (TFMS) on an NMR logging tool are used to produce a static magnetic field in a formation surrounding a borehole. The TFMs are made of material having a high T.sub.c, so that the magnetic field can be sustained for the duration of the well logging by enclosing the TFMs within a cryostat containing liquid nitrogen as a coolant. By using the TFMs, the field strength within this region is much higher than is attainable with conventional magnets, giving an improved signal to noise (S/N) ratio for the NMR signals. The magnetic field strength within the TFMs is kept at a low enough value that instability problems associated with these materials do not arise. The field strength may be selected based upon knowledge of the resistivity and dielectric constant of the formation and the associated skin depth for electromagnetic signals. This makes it possible to use the TFMs in both wireline and measurement while drilling (MWD) environments. In one embodiment of the invention, the TFMs are magnetized outside the borehole environment using conventional high field strength electromagnets prior to emplacement within the cryostats. In another embodiment of the invention, vortex currents within the TFMs are induced in situ over a period of time, so that the power requirements for the inducing field are attainable in a borehole environment. A pulsed radio frequency (RF) magnetic field is produced using an RF antenna in the NMR tool that is orthogonal to the direction of the static magnetic field. The NMR pulse echo signals induced in the formation indicative of a parameter of interest in the formation is received by a receiver on the tool

19 Claims, 13 Drawing figures

☐ 3. Document ID: US 6445180 B1 Relevance Rank: 99

L5: Entry 12 of 20 File: USPT Sep 3, 2002

US-PAT-NO: 6445180
DOCUMENT-IDENTIFIER: US 6445180 B1

TITLE: Nuclear magnetic resonance tool with active RF spoiler antenna

DATE-ISSUED: September 3, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
WO 02/01255	March 2002	EP	
WO 99/42858	August 1999	WO	

ART-UNIT: 2862

PRIMARY-EXAMINER: Lefkowitz; Edward

ASSISTANT-EXAMINER: Fetzner; Tiffany A.

ATTY-AGENT-FIRM: Madan, Mossman & Sriram, P.C.

ABSTRACT:

A novel nuclear magnetic resonance (NMR) probe design for operating in a bore hole to obtaining the NMR characteristics of a region of interest adjacent the bore hole, characterized by a main RF antenna, a magnet, and a spoiler antenna. The spoiler antenna performs as an active shield for generating a resultant RF field that forcefully mismatches the static magnetic field inside the bore hole and substantially does not affects the RF field or antenna sensitivity in the region of interest.

44 Claims, 10 Drawing figures

☐ 4. Document ID: US 6525535 B2 Relevance Rank: 99

L5: Entry 10 of 20 File: USPT Feb 25, 2003

US-PAT-NO: 6525535
DOCUMENT-IDENTIFIER: US 6525535 B2

TITLE: NMR apparatus for oil well logging of large and small diameter wells

DATE-ISSUED: February 25, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Reiderman; Arcady	Houston	TX		
Beard; David R.	Houston	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Baker Hughes Incorporated	Houston	TX			02

APPL-NO: 09/997451 [PALM]
DATE FILED: November 30, 2001

formation during a transmission pulse. For large holes, the invention works in a side-looking mode and the antenna assembly operates both to match the iso-lines of the static magnetic field within the rock formation and to diminish the magnetic field within the borehole during a transmission pulse. The secondary antenna can also be used as a receiver of spin echo signals, or optionally, to make adjustments to the received signal.

16 Claims, 5 Drawing figures

☐ 5. Document ID: US 6900630 B2 Relevance Rank: 99

L5: Entry 6 of 20 File: USPT May 31, 2005

US-PAT-NO: 6900630
DOCUMENT-IDENTIFIER: US 6900630 B2

TITLE: Azimuthal NMR imaging of formation properties from a wellbore

DATE-ISSUED: May 31, 2005

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Edwards; Carl M.	Katy	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Baker Hughes Incorporated	Houston	TX			02

APPL-NO: 10/717123 [PALM]
DATE FILED: November 19, 2003

PARENT-CASE:
CROSS-REFERENCES TO RELATED APPLICATIONS This application claims priority from U.S. Provisional Patent Application Ser. No. 60/427,630 filed on Nov. 19, 2002.

INT-CL-ISSUED: [07] G01V 3/00

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	G01 R 33/44	20060101
CIPS	G01 V 3/18	20060101
CIPS	G01 V 3/32	20060101

US-CL-ISSUED: 324/303; 324/314
US-CL-CURRENT: 324/303; 324/314

FIELD-OF-CLASSIFICATION-SEARCH: 324/303, 324/314, 324/300, 324/306, 324/307, 324/309, 324/312, 324/318, 324/322

See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
3124741	March 1964	Primas	325/0.5
4307343	December 1981	Likes	324/307
4646020	February 1987	Brown	324/303
4717877	January 1988	Taicher et al.	324/303
5055787	October 1991	Kleinberg et al.	324/303
5415163	May 1995	Harms et al.	600/410
5488342	January 1996	Hanley	335/306
5646528	July 1997	Hanley	324/303
5977768	November 1999	Sezginer et al.	324/303
6023164	February 2000	Prammer	324/303
6166540	December 2000	Wollin	324/300
6255817	July 2001	Poitzsch et al.	324/303
6291995	September 2001	Speier et al.	324/303
6326784	December 2001	Ganesan et al.	324/303
6429654	August 2002	Itskovich et al.	324/314

ART-UNIT: 2859

PRIMARY-EXAMINER: Arana; Louis

ATTY-AGENT-FIRM: Madan, Mossman & Sriram, P.C.

ABSTRACT:

A method and apparatus for performing NMR measurements suppressing contribution to NMR signals from within the borehole. Within the region of examination, the RF magnetic field has a spatially varying intensity. NMR signals (free induction decay or spin echo signals) are inverted to give spin density as a function of field intensity. This inversion is then mapped to spatial positions using the known RF field variation. The effect of signals arising from within the borehole can be suppressed. It is also possible to obtain an azimuthal image of the spin density.

31 Claims, 13 Drawing figures

☐ 6. Document ID: US 20040066194 A1 Relevance Rank: 99

L5: Entry 2 of 20 File: PGPB Apr 8, 2004

Hit List

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Search Results - Record(s) 1 through 4 of 4 returned.

☐ 1. Document ID: US 5712566 A Relevance Rank: 65

L16: Entry 3 of 4 File: USPT Jan 27, 1998

US-PAT-NO: 5712566
DOCUMENT-IDENTIFIER: US 5712566 A

TITLE: Nuclear magnetic resonance apparatus and method

DATE-ISSUED: January 27, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Taicher; Gersh Zui	Rehovot			IL
Reiderman; Arcady	Rehovot			IL

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Western Atlas International, Inc.	Houston	TX			02

APPL-NO: 08/606089 [PALM]
DATE FILED: February 23, 1996

INT-CL-ISSUED: [06] G01V 3/14

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	G01 V 3/32	20060101
CIPS	G01 V 3/18	20060101
CIPS	G01 R 33/44	20060101
CIPN	G01 R 33/54	20060101
CIPN	G01 R 33/563	20060101

US-CL-ISSUED: 324/303
US-CL-CURRENT: 324/303

FIELD-OF-CLASSIFICATION-SEARCH: 324/300, 324/303, 324/307, 324/309, 324/318, 324/322, 335/302, 335/306
See application file for complete search history.

PRIOR-ART-DISCLOSED:

☐ 2. Document ID: US 5834936 A Relevance Rank: 65

L16: Entry 2 of 4 File: USPT Nov 10, 1998

US-PAT-NO: 5834936
DOCUMENT-IDENTIFIER: US 5834936 A

TITLE: Nuclear magnetic resonance apparatus and method

DATE-ISSUED: November 10, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Taicher; Gersh Zvi	Houston	TX		
Reiderman; Arcady	Houston	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Western Atlas International, Inc.	Houston	TX			02

APPL-NO: 08/902683 [PALM]
DATE FILED: July 30, 1997

PARENT-CASE:
CROSS REFERENCE TO RELATED APPLICATIONS This is a division of application Ser. No. 08/606,089 filed on Feb. 23, 1996 now U.S. Pat. No. 5,712,566.

INT-CL-ISSUED: [06] G01V 3/00

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	G01 V 3/32	20060101
CIPS	G01 V 3/18	20060101
CIPS	G01 R 33/44	20060101
CIPN	G01 R 33/563	20060101
CIPN	G01 R 33/54	20060101

US-CL-ISSUED: 324/303; 324/314
US-CL-CURRENT: 324/303; 324/314

FIELD-OF-CLASSIFICATION-SEARCH: 324/303, 324/300, 324/318, 324/322, 324/307, 324/309, 324/314
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4714881	December 1987	Givens	324/303

5646528	July 1997	Hanley	324/303
5680044	October 1997	McDougall et al.	324/303

ART-UNIT: 287

PRIMARY-EXAMINER: Arana; Louis

ATTY-AGENT-FIRM: Fagin; Richard A.

ABSTRACT:

A nuclear magnetic resonance sensing apparatus, comprising a magnet for inducing a static magnetic field in a region containing materials to be analyzed. The magnet has a longitudinal axis and substantially uniform magnetization along the axis. The apparatus includes a system for generating a radio frequency magnetic field to excite nuclei of the materials to be analyzed, which includes a first antenna having an axial length shorter than a length along the axis over which the magnet has said substantially uniform magnetization. The axial length of the first antenna is shorter in a direction of motion of the apparatus so that the radio frequency magnetic field excites the nuclei where they are substantially prepolarized by the static magnetic field to an equilibrium state along the direction of motion. The apparatus includes a system for receiving nuclear magnetic resonance signals from the excited nuclei. In a particular embodiment, the receiving system includes a second antenna having a sensitive length shorter than the axial length of the first antenna in the direction of motion, so that the second antenna detects nuclear magnetic resonance signals from substantially fully radio frequency excited nuclei in the materials to be analyzed.

20 Claims, 18 Drawing figures

☐ 3. Document ID: US 6118272 A Relevance Rank: 65

L16: Entry 1 of 4 File: USPT Sep 12, 2000

US-PAT-NO: 6118272
DOCUMENT-IDENTIFIER: US 6118272 A

TITLE: Nuclear magnetic resonance apparatus and method

DATE-ISSUED: September 12, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Taicher; Gersh Zvi	Houston	TX		
Reiderman; Arcady	Houston	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE

disposed within the second region. The apparatus includes means for receiving a nuclear magnetic resonance signal from the excited nuclei. In a preferred embodiment, the means for generating and means for receiving include an antenna at least partially disposed within the second region. In a specific embodiment, the antenna consists of wire coils wound in planes perpendicular to the longitudinal axis of the instrument. A high permeability ferrite is disposed inside the wire coils of the antenna.

12 Claims, 18 Drawing figures

☐ 4. Document ID: US 3083335 A Relevance Rank: 64

L16: Entry 4 of 4 File: USOC Mar 26, 1963

US-PAT-NO: 3083335
DOCUMENT-IDENTIFIER: US 3083335 A

TITLE: Magnetic resonance methods and apparatus

DATE-ISSUED: March 26, 1963

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPP	G01 V 3/14	20060101

US-CL-CURRENT: 324/303

DOCUMENT TEXT:

March 26, 1963 N. A. SCHUSTER 3,0839335 MAGNETIC RESONANCE METHODS AND APPARATUS Filed Oct. 5, 1955 4 Sheets-Sheet I 24 23 25 ILTER 12 X, -19 16 13 17 c u I I FIG. I r-i-pi- "2 GATE F11171 PULSES \18 Rf),WM PULSES 20 2 DET'ECTED AAA AAA PULSES FIG. 2 INVENTOR. NICK A. SCHUSTER BY HIS ATTORNEY

March 26, 1963 N. A. SCHUSTER 3,083,335 MAGNETIC RESONANCE METHODS AND APPARATLTS Filed Oct. 5, 1955 4 Sheets-Sheet 2 24 26 22 "_-27 [(O DETECTOR 12: x ---- - ------ ---- 13@ 33 ING CIRCUIT 28 9 OSC.fo FIG. 3 A 7771 --Jt I t t? ti 2'ff B _4r FIG. 4 I J V V E N T O R . NICK A. SCHUST ER BY atto @ &-I-= HIS ATTORNIEY

March 26, 1963 N. A. SCHUSTER 3@083,335 MAGNETIC RESONANCE METHODS AND APPARATUS Filed Oct. 5, 1955 4 Sheets-Sheet 3 0 tn Ln OD Z cn x (r u w LLJ CC cli CD t,j U) 40 ui C"@ w w Ul) a. ul (01 a: to C-i C4 pg- cli cu a: x 10 fo to INVENTOR. NICK A. SCHUSTER HIS ATTORIN

March 26, 1963 N. A. SCHUSTER 3@0839335 MAGNETIC RESONANCE METHODS AND APPARATUS Filed Oct. 5, 1955 4 Sheets-Sheet 4 44 48 r ---- 27 22 TOR 10 45 48 I x 13 41 -\70 c 15 14 FIG. 6 ' 7 r A 39 42 d--39 47' 47 43 46' 46' B 47 46 7 r46 FIG. 7 INVENTOR. 'NICK A. SCHUSTER B rll,.) Al IUKllgtT

3 @ 0 8 3 9 3 3 5 United States Paie-nt Office P a t e n t e d M a r . 2 6 , 1 9 6 3 2 difl icult to detect in the presence of the relatively large 3,083,335 alt emating field at the same frequency. zkZESOiNANCE METHODS AND Aecordin.aly, it is a

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Search Results - Record(s) 1 through 4 of 4 returned.

☐ 1. Document ID: US 3083335 A Relevance Rank: 46

L17: Entry 4 of 4 File: USOC Mar 26, 1963

US-PAT-NO: 3083335
DOCUMENT-IDENTIFIER: US 3083335 A

TITLE: Magnetic resonance methods and apparatus

DATE-ISSUED: March 26, 1963

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPP	G01 V 3/14	20060101

US-CL-CURRENT: 324/303

DOCUMENT TEXT:

March 26, 1963 N. A. SCHUSTER 3,0839335 MAGNETIC RESONANCE METHODS AND APPARATUS Filed Oct. 5, 1955 4 Sheets-Sheet I 24 23 25 ILTER 12 X, -19 16 13 17 c u I I FIG. I r-i-pi- "2 GATE F11171 PULSES \18 Rf),WM PULSES 20 2 DET'ECTED AAA AAA PULSES FIG. 2 INVENTOR. NICK A. SCHUSTER BY HIS ATTORNEY

March 26, 1963 N. A. SCHUSTER 3,083,335 MAGNETIC RESONANCE METHODS AND APPARATLTS Filed Oct. 5, 1955 4 Sheets-Sheet 2 24 26 22 "_-27 [(O DETECTOR 12: x ---- - ------ ---- 13@ 33 ING CIRCUIT 28 9 OSC.fo FIG. 3 A 7771 --Jt I t t? ti 2'ff B _4r FIG. 4 I J V V E N T O R . NICK A. SCHUST ER BY atto @ &-I-= HIS ATTORNIEY

March 26, 1963 N. A. SCHUSTER 3@083,335 MAGNETIC RESONANCE METHODS AND APPARATUS Filed Oct. 5, 1955 4 Sheets-Sheet 3 0 tn Ln OD Z cn x (r u w LLJ CC cli CD t,j U) 40 ui C"@ w w Ul) a. ul (01 a: to C-i C4 pg- cli cu a: x 10 fo to INVENTOR. NICK A. SCHUSTER HIS ATTORIN

March 26, 1963 N. A. SCHUSTER 3@0839335 MAGNETIC RESONANCE METHODS AND APPARATUS Filed Oct. 5, 1955 4 Sheets-Sheet 4 44 48 r ---- 27 22 TOR 10 45 48 I x 13 41 -\70 c 15 14 FIG. 6 ' 7 r A 39 42 d--39 47' 47 43 46' 46' B 47 46 7 r46 FIG. 7 INVENTOR. 'NICK A. SCHUSTER B rll,.) Al IUKllgtT

3 @ 0 8 3 9 3 3 5 United States Paie-nt Office P a t e n t e d M a r . 2 6 , 1 9 6 3 2 difl icult to detect in the presence of the relatively large 3,083,335 alt emating field at the same frequency. zkZESOiNANCE METHODS AND Aecordin.aly, it is a primary objectof the present inven- A,PPAIZAT'US -@e@ eid, Conn., Pssignor, by mesne tion to provide new and improved methods Nie'A A. -X' ge-f and a@para- --ss' @4) -9e,4-@iuriberger Sur,,,cy-.ng Corpo- 5 tus for detecting magnetic resonance phenomena which .-atio'n, Tex,, a of Texas are of I particular utility where high degrees of field homo- Fiied CCl. 5, '@955, Ser. No. 538,578 geneities are not

iprising the steps of applying a magnetic field to said particles in successive earth formations in a given dircetion during first time intervals anc.1 iii an opposite direction during alternate time intervals which tijne inti@,rvals ar@,-long -relativi@, to the time for reversing 70 s@id magnatic field, and during said time intervals detec - t ing the magnetic relaxation si-- nal rcsulting from relax4tion of the macroscopic magnetic inoment associated with said particles toward alignmcnt with said magneti@, field. 75 (References on following page)

References Cited in the file of this patent UNITED STATES PATENTS 2,561,489 Bloch et al - ---------- July 24, 1951 2,705,790 Hahn ---------- Apr. 5, 1955 OTHER REFERENCES Bloember,-en et al.: Physical Review, vol. 93, No. 1, Jan. 1, 1954, pp. 72-83. Damon: Reviews of Modem Physica, vol. 25, No. 1, January 1953, pp. 239-245. Bloom et al.: Physical Review, vol. 97, No. 6 pp. 16991709, Mar. 15, 1955. 3,083,335 12 Physic-al Review, vol 93, No. 4, February 1954, page 941, Abstracts A7 and A8. "Relaxation Effects in Nuclear Magnetic Resonance Absorption," by Bloem,,bergen et al., "Physical Review," vol. 73, No. 7, April 1948, pp. 679-712. "Measurement of Electronic Susceptibilities by Means of Nuclear Resonance Absorption," by Feher et al., "Rev. of Sci. Inst.," vol. 26, No. 31 March 1955. Hahn: Physical Review, vol. 76, No. 1, July 1, 1949, 10 pp. 145-146; . - Torrey: Physical Rev@iew, vol. 76. No. 8, Oct. 15, 1949, pp. 1059-1066.

Notice of Adverse Decision in Interference In Interference No. 93,939 involving Patent No. 3,083,335, N. A. Schuster, MAGNETIC RESONANCE METHODS AND APPARATUS, fiiial judgment adverse tp the patentee was rendered Jan. 29, 1970, as to claim 8@. [O#Czal Gazette JuZy 7, 1970.1

Disclaimer 3,083,335.-Nick A. Schuster, Ridgefield, Conn. MAGNETIC RESOINTANCE METHODS AND APPARATUS. Patent dated Mar. 26,1963. Disclaimer filed May 15,19TO, by the assignee, Schlumberger Tecknology Corporation. Hereby ent-ers this disclaimer to claim 8 of said patent. [Offloial Gazette, August 18,1970.]

☐ 2. Document ID: US 5834936 A Relevance Rank: 46

L17: Entry 2 of 4 File: USPT Nov 10, 1998

US-PAT-NO: 5834936
DOCUMENT-IDENTIFIER: US 5834936 A

TITLE: Nuclear magnetic resonance apparatus and method

DATE-ISSUED: November 10, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Taicher; Gersh Zvi	Houston	TX		
Reiderman; Arcady	Houston	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Western Atlas International, Inc.	Houston	TX			02

APPL-NO: 08/902683. [PALM]

DATE FILED: July 30, 1997

PARENT-CASE:
CROSS REFERENCE TO RELATED APPLICATIONS This is a division of application Ser. No. 08/606,089 filed on Feb. 23, 1996 now U.S. Pat. No. 5,712,566.

INT-CL-ISSUED: [06] G01V 3/00

INT-CL-CURRENT:

TYPE IPC	DATE
CIPS G01 V 3/32	20060101
CIPS G01 V 3/18	20060101
CIPS G01 R 33/44	20060101
CIPN G01 R 33/563	20060101
CIPN G01 R 33/54	20060101

US-CL-ISSUED: 324/303; 324/314
US-CL-CURRENT: 324/303; 324/314

FIELD-OF-CLASSIFICATION-SEARCH: 324/303, 324/300, 324/318, 324/322, 324/307, 324/309, 324/314
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4714881	December 1987	Givens	324/303
5646528	July 1997	Hanley	324/303
5680044	October 1997	McDougall et al.	324/303

ART-UNIT: 287

PRIMARY-EXAMINER: Arana; Louis

ATTY-AGENT-FIRM: Fagin; Richard A.

ABSTRACT:

A nuclear magnetic resonance sensing apparatus, comprising a magnet for inducing a static magnetic field in a region containing materials to be analyzed. The magnet has a longitudinal axis and substantially uniform magnetization along the axis. The apparatus includes a system for generating a radio frequency magnetic field to excite nuclei of the materials to be analyzed, which includes a first antenna having an axial length shorter than a length along the axis over which the magnet has said substantially uniform magnetization. The axial length of the first antenna is shorter in a direction of motion of the apparatus so that the radio frequency magnetic field excites the nuclei where they are substantially prepolarized by the static magnetic field to an equilibrium state along the direction of motion. The apparatus includes a system for receiving nuclear magnetic resonance signals from

the excited nuclei. In a particular embodiment, the receiving system includes a second antenna having a sensitive length shorter than the axial length of the first antenna in the direction of motion, so that the second antenna detects nuclear magnetic resonance signals from substantially fully radio frequency excited nuclei in the materials to be analyzed.

20 Claims, 18 Drawing figures

☐ 3. Document ID: US 6118272 A Relevance Rank: 46

L17: Entry 1 of 4 File: USPT Sep 12, 2000

US-PAT-NO: 6118272
DOCUMENT-IDENTIFIER: US 6118272 A

TITLE: Nuclear magnetic resonance apparatus and method

DATE-ISSUED: September 12, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Taicher; Gersh Zvi	Houston	TX		
Reiderman; Arcady	Houston	TX		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Western Atlas International, Inc.	Houston	TX			02

APPL-NO: 08/902682 [PALM]
DATE FILED: July 30, 1997

PARENT-CASE:
CROSS REFERENCE TO RELATED APPLICATIONS This is a division of application Ser. No. 08/606,089 filed on Feb. 23, 1996, now U.S. Pat. No. 5,712,566.

INT-CL-ISSUED: [07] G01V 3/00

INT-CL-CURRENT:

TYPE	IPC	DATE
CIPS	G01 V 3/32	20060101
CIPN	G01 R 33/54	20060101
CIPN	G01 R 33/563	20060101
CIPS	G01 R 33/44	20060101
CIPS	G01 V 3/18	20060101

US-CL-ISSUED: 324/303; 324/318
US-CL-CURRENT: 324/303; 324/318

FIELD-OF-CLASSIFICATION-SEARCH: 324/303, 324/300, 324/318, 324/322, 324/319, 324/320, 335/229
See application file for complete search history.

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
4717876	January 1988	Masi et al.	324/303
5471140	November 1995	Hanley	324/303
5488342	January 1996	Hanley	324/303

ART-UNIT: 287

PRIMARY-EXAMINER: Arana; Louis

ATTY-AGENT-FIRM: Fagin; Richard A.

ABSTRACT:

A nuclear magnetic resonance apparatus including a magnet generating a static magnetic field in a first region containing materials to be analyzed. The magnet generates zero static magnetic field in a second region. The magnet has generally homogeneous magnetization along a longitudinal axis and is magnetized substantially perpendicular to the axis. The apparatus includes means for generating a radio frequency magnetic field in the first region for exciting nuclei of the materials. The means for generating the radio frequency magnetic field includes an antenna disposed within the second region. The apparatus includes means for receiving a nuclear magnetic resonance signal from the excited nuclei. In a preferred embodiment, the means for generating and means for receiving include an antenna at least partially disposed within the second region. In a specific embodiment, the antenna consists of wire coils wound in planes perpendicular to the longitudinal axis of the instrument. A high permeability ferrite is disposed inside the wire coils of the antenna.

12 Claims, 18 Drawing figures

☐ 4. Document ID: US 5712566 A Relevance Rank: 46

L17: Entry 3 of 4 File: USPT Jan 27, 1998

US-PAT-NO: 5712566
DOCUMENT-IDENTIFIER: US 5712566 A

TITLE: Nuclear magnetic resonance apparatus and method

M. N. Miller et al, "Spin Echo Magnetic Resonance Logging: Porosity and Free Fluid Index Determination" paper No. 20561, Society of Petroleum Engineers, Richardson, TX (1990).

ART-UNIT: 225

PRIMARY-EXAMINER: O'Shea; Sandra L.

ASSISTANT-EXAMINER: Phillips; Roger

ATTY-AGENT-FIRM: Fagin; Richard A.

ABSTRACT:

A nuclear magnetic resonance apparatus including a magnet generating a static magnetic field in a first region containing materials to be analyzed. The magnet generates zero static magnetic field in a second region. The magnet has generally homogeneous magnetization along a longitudinal axis and is magnetized substantially perpendicular to the axis. The apparatus includes means for generating a radio frequency magnetic field in the first region for exciting nuclei of the materials. The means for generating the radio frequency magnetic field includes an antenna disposed within the second region. The apparatus includes means for receiving a nuclear magnetic resonance signal from the excited nuclei. The means for receiving also provides an output indication of properties of the materials to be analyzed. In a preferred embodiment, the means for generating and receiving include an antenna at least partially disposed within the second region. In a specific embodiment, the antenna consists of wire coils wound in planes perpendicular to the longitudinal axis. A high permeability ferrite is disposed inside the wire coils.

35 Claims, 18 Drawing figures

Term	Documents
(14 AND 8 AND 10).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	4
(L8 AND L14 AND L10).PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD.	4